R0055
592 0055

HOOPER

HIAWATHA NATIONAL FOREST

RECREATION USE SAMPLING PROCEEDURES

By

James Hooper

&

Charles Prausa

January 20, 1981

80

TABLE OF CONTENTS

ABSTRACT

The Hiawatha National Forest occurs as two units in Michigan's Upper Peninsula. Visitors travel primarily from Canada, lower Michigan and western Michigan to use the National Forest. Assessment of this use has been sporadic and of varying value. Poor use measurements have been a result of dollar limitations, knowledge deficiencies and lack of direction.

The system proposed highlights the research work which has been done and applies the techniques available to specific visitor use activities. As an alternative to the past practice of automatically double sampling one developed site/year, the techniques provide a means to develop a more beneficial use sampling operation.

For each activity a minimum of one sampling alternative is suggested. A statistical section explains the statistics involved in use sampling and explains the procedures involved in developing additional alternative systems to fit a particular situation.

INTRODUCTION

While accurate recreation use measurements have been long needed, they have just recently been tied to regional targets. In Fiscal Year 1981, a minimum of 25% of developed recreation sites are to be sampled to reliability codes 1, 2 or 3. At least 25% of dispersed uses are to meet a reliability code of 4 or better. These codes relate to the accuracy of the sample and are defined as follows:

Reliability Code	Description	Maximum Error Term @ the 80% Confidence Limit
1	At least 85% of year long use measured by approved statistical methods.	10%
2	Approved sampling systems.	25%
3	Samples with error terms greater than 25%. Estimate from actual counts such as resort occupancy, ticket sales, etc.	N/A
4	Estimates from traffic counts, trail counter, visitor registration etc.	N/A
5	Simple observations. Guesses. Also see RIM H.B 124.32b	N/A

Since the error term applies to codes 1 and 2, a statistical analysis is needed for a sample to meet those levels. The error term is synonymous with standard error of the mean and sampling error. The statistical analysis section describes how the error term is derived and how statistics relate to the sampling system. For planning, the maximum error term permitted by RIM is ± 25%. This is at a 67% confidence level; (i.e. actual use will fall within the confidence limits two out of every three times a sample is taken).

As the desired error term increases, sampling cost usually increase since the error terms varies by the square of the number of samples. If, for example, the error term is to be reduced by ½, then 4 times as many samples will need to be taken. Another factor related to the error is the intensity of the sample. For example, double sampling as described by the RIM handbook required 12 hours of sampling per sample day. To reduce costs, sampling could be reduced to two random hours in the sample day. Of course, the error term would probably increase with the resulting increase in variation.

The section on sampling methods outlines alternatives for sampling the various activities. However, for some activity groups or specific sites, none of the alternatives will fit. For these areas a more site/specific system will have to be developed. Quite often these sampling problems appear very complex. But, usually if the situation is care-

fully studied, a simple approach can be devised. The first step is to map out the specific use patterns by determining who the user groups are, where they originate from and how they get to the activity location. This, along with a time sequence will usually show some point where the users are funneled together. It may be at the beginning (e.g. ORV clubs in a population center), middle (e.g. trail heads), or end (e.g. campgrounds). The statistical analysis section describes how to devise a sampling system for a particular situation. In using these procedures, care must be taken to eliminate bias. This is usually done by taking random samples. However, unintentional bias may occur even where random sampling is adapted. For example, if double sampling is used from 9:00 a.m. - 9:00 p.m., a significant amount of fishing use may be missed since a good deal of fishing occurs between 5:00 a.m. and 9:00 a.m.

A good deal of effort and money may be saved through contacts with other agencies or staff groups. For example, 1.) in Michigan, the DNR collects snowmobile and hunter counts, 2.) the states and counties collect traffic counts, 3.) bridge counts are maintained at the Macinac and International bridges, and 4.) most engineering units collect traffie counts. In addition, a measurement obtained from one sampling design may indicate trends in another activity. An obvious example would be: a measured 2% increase in trail use would indicate a similar increase in dispersed camping use along the trail.

If use information is not available, special equipment may be needed to collect it. Appendix 3 lists some of the equipment available and Appendix 4 shows how to assemble and install one piece of equipment - the pressure plate counter.

Since budgets are usually very limited, intensive sampling should be done only on those areas and activities which are necessary for management purposes. Any targets, such as the regional targets previously discussed, must be tied to budget levels.

The sampling methods section proposes various alternatives which vary in cost. Each alternative is given a suggested reliability code. The individual situation must be weighed against the criteria previously outlined.

LITERATURE REVIEW

Most of the research concerning measuring recreation use has occurred since the passage of the Multiple Use and Sustained Yield Act in 1960. Primarily, most successful research has been with measuring individual activities and use on developed sites.

James (1966 & 1967) devised one of the best known developed site sampling systems. His work is the basis for the double sampling system described in the RIM handbook. In this system, a developed site complex is measured through observation coupled with season long measurements of visits. Visits are usually counted using traffic counters or water meters.

An exception to the single activity measurement is James and Henley (1968). Use measurements covering an entire district can be obtained by identifying the roads and trails which cross the district boundary and interviewing visitors as they leave the district. The interviews provide measurements on the number of visitors and amount of time they spent in various activities. The cost of using this "cordon" method is approximately $35,000.

Both managers and researchers have expressed a need for simple low cost measuring methods and equipment. Driessen (1979), through interviews with recreation managers, found this to be especially true for dispersed activities. The equipment and methods he found being used include: infrared trail counters alone and coupled with visual observations, magnetic loops alone and with cameras, counters on outhouse doors, aerial reconnaissance, pneumatic counters, sound activated recorders on primitive airstrips, and time lapse cameras.

Tombaugh and Love (1964) evaluated three of the commonly used methods. Measurements based on Sporadic counts by recreation guards, traffic counters and estimates by field personnel were evaluated with actual count estimates. The estimates made by field personnel were very inaccurate. The other two methods gave similar results, but both had errors due to double counting or counting off-site users. Full day counts are recommended to refine the data from these methods. Elsner (1970) also found counters that did not give accurate measurements. Counters record both the movement of the registered camper in and out of the site for other activities and prospective campers. The prospective camper is the individual who looks for, but does not find a suitable site. The counts for these individuals increase as the campground approaches and reaches maximum capacity.

James and Schreuder (1972) suggests using infrared counters coupled with self-registration to obtain more accurate counts. The need for careful installation and periodic checks of the infrared counter became evident in their work. Bury (1964) also used registration for use estimates, but found low registration compliance from some groups such as local users caused errors. For accurate estimates of use, the registration rate must be measured.

The types of counters and methods in trail use is covered by Leonard et. al. (1980). They discuss using registration systems, pressure plate counters

photo-electric counters and time lapse photography. Based on their review, the most accurate for the cost is the pressure plate counter. Appendix No. 4 describes the set up of this system.

James, Wingle and Griggs (1971) describe how to use the instant count method of sampling for measuring boating use on large bodies of water. Schreuder (1975) explains how a count of the total number of users made in a very short (instant) interval of time is assumed to represent the use occurring throughout a specific period of time. The specific period is usually one to four hours. The count is "Blown-up" to give a measurement of total use. By coupling the counts with a traffic counter, future years use can be measured through a regression formula.

Saunders (1980) used the instant count and other sampling methods to recommend specific means of measuring use for each activity. He proposed cutting costs by measuring only visits and using a set of standard average length of stay figures to obtain recreation visitor days (RVD's). Also proposed is a reduction in the double sampling intensity shown in the RIM handbook. Instead of sampling every hour in the twelve hour sampling day, Saunders suggests sampling only two random hours. Of course these two proposals would result in higher errors along with reduced costs. Saunders also found that use tends to be double counted if it is divided into very many activities.

Some cautions in sampling were also made by James and Quinhert (1972), who found after they began their sampling on observation sites that they were not sampling the entire day use period. Their use of printout counters showed significant use occurring after their sample day had ended. This discovery indicated the public could be better hosted if the VIS building was left open an extra two hours per day. Projecting use measurements very far into the future was cautioned against by Moncrief (1980) when he pointed out energy shortages and cost will undoubtedly affect use. These changes could be in user preference, user groups and amount of use. These changes could come very quickly. The Missoula Equipment and Development Test Center is currently working on equipment to monitor changing use. In the past, they developed the infrared counter and now are testing magnetic loop counters with printouts, lower power requirements and smaller sizes.

SAMPLING METHODS

Overview

To simplify the RIM reporting and help minimize overcounting of use, only the activities listed in Appendix No. 2 may be used. Along with each activity a suggested visitor hour value is shown. These visitor hour values represent the average length of time a visitor will participate in a given activity per 24 hour period. Use of activities other than those shown must be justifiable and approved by the Supervisor's office. If the visitor hour values are used, or if the standard 3.4 people/car is used in an analysis, the sample cannot be given a reliability code of one even if the error term is acceptable.

Before sampling, the desired accuracy level must be determined. This will dictate the intensity of sampling and may be based simply on the desired reliability level or on a statistical goal. The following section on specific sampling methods for each activity show reliability levels while the statistical analysis section shows how to reach statistical goals.

For many of the proposed sampling systems, the data may be most economically collected by using a district tally sheet. On this sheet district personnel record the number of users at the sampling site either as they make their rounds or at randomly chosen times. If the recording is done as part of normal maintenance, the routes should be varied to give samples covering the entire use day. Even then the sampling will probably be biased. To overcome this, the samples could be listed in time periods, such as two hour classes and systematically sampled.

In all sampling efforts, when measurements are taken, count all individuals by the activity they are engaged in which most affects management. For example, if hunting use is being measured, those people hunting from vehicles should be counted in hunting instead of driving for pleasure since their hunting is what impacts management practices the most.

Alternatives

Viewing Outstanding Scenery

Use the instant count method as outlined in the RIM Handbook 124.74 and as shown in Appendix No. 2. A traffic counter can be used to obtain a correlation between use and vehicle count. Use data can then be generated for the next 4 years based solely on the vehicle count.

This type of sampling method will provide data at a reliability code 3. If statistical analysis is used and the sample is kept random, reliability codes 1 or 2 may be reached.

Driving For Pleasure

Visitor days can be calculated using vehicle counts supplied by Michigan Department of Transportation and randomly placed counters. The Supervisor's

Engineering staff has traffic counts for state highways. County road traffic counts are available through local road commission offices.

Appendix No. 8 shows Road Class summaries by district. These were obtained using the forest transportation map and the following criteria:

Class I - Primitive; roads not graded or drained.

Class II - Improved; roads graded and drained.

Class III - Locally maintained; usually by county.

Class IV - Forest highways.

To determine use on Class I and II roads, traffic counts will have to be made or if a lower reliability is acceptable, an average of 4 rec. vehicles/day may be used for Class I roads and 13/day for Class II.

The method for determining total use is shown in the following example:

Formula Symbols -		Miles	ADT	P.C.	T.T.	Days	L.R.	
Road Class	Avg. Rd. Speed (1)	Mi. in Class	Avg. Daily Traffic (3)	People/ Car (4)	Time in Decimal Hrs. to Travel 1 mi.	No. of days used in year (2)	Local Reduction Factors (5)	RVD's use/yr.
1	20	250	8	3.4	.100	225	.92	11730
2	35	130	10	3.4	.050	250	.92	4235
3	40	180	20	3.4	.033	300	.92	9290
4	55	110	40	3.4	.022	365	.92	9210
							TOTAL USE	34465

(1) Taken from Appendix.

(2) This is a weighted average of roads open year round and those not plowed.

(3) From state and county and sample results.

(4) Use an average of 3.4 people/car unless observations show otherwise.

(5) Use 92% recreational unless observation show a different local use.

The RVD's by road class are calculated by taking Miles x ADT x P.C x T.T x Days x L.R. ÷ 12. The 12 takes total hours of use and changes it to RVD's. The formula for Road Class I in the above example would be: 250 x 8 x 3.4 x .1 x 225 x .92 ÷ 12 = 11730 days. The total RVD's use

is simply the sum of all road classes.

The above procedure will give a reliability Code 3 if traffic counts are taken for Class I and II roads or a Code 4 if the averages are used.

Motorcycling and Off-Road

Use the same procedures as driving for pleasure. Based on 1978 traffic counts obtained from the Mackinac Bridge Authority, 1% of all vehicles were motorcycles. This applied to the traffic counts gives a reliability Code of 3 or 4 as in the driving for pleasure sampling.

For measurement of ORV's on trails, counters alone would give reliability Code of 4.

Snowmobiling

Snowmobiling can be measured in a fashion similar to driving for pleasure. The Michigan DNR takes counts on groomed trails. The remaining trails can be broken into as many trail classes as is appropriate. Vehicle counts can be obtained using magnetic loop or infrared counters. Observations will have to be made to obtain average people/machine and average speed. A reliability Code 3 is appropriate for this type of sampling.

Boating - Powered, Sailing & Canoeing

Alternative 1

For areas with distinct access points, use information can be obtained by double sampling at boat launch sites. Sampling day observations will give the average number of people per boat and number of boaters putting in per hour. The number of samples to be taken will depend on variation in use and accuracy desired. As a minimum for reliability Code 2, the following should be done: Divide the season into high (weekend and holidays) and low (weekdays) use days. Randomly choose six days from each category. Divide the use portion of the sample day into one hour intervals and randomly select two one hour intervals. For measuring future years use, a counter should be installed and a regression analysis as shown in the RIM Handbook 124.74C made. Double sampling procedures are also explained in the RIM Handbook 124.72b.

If there are too many launch sites to sample, then they can be grouped into similar units (stratified) and these groups can be randomly sampled. The sample measurements can then be expanded to represent the total use in a group. Statistical analysis of this sampling system will probably give a reliability Code 2. Since the average length of stay figure is used, this is the highest code obtainable.

Alternative 2

For powered boating and sailing on lakes, the procedures as outlined in the RIM Handbook 124.74a may be followed for a probable reliability Code of 1. As mentioned in Alternative 1, if there are too many lakes to sample, they may be stratified and subsampled.

Alternative 3

For river boating, use may be counted using infrared counters, (if water fluctuation is not too great), or time lapse movie cameras. These measurements coupled with randomly selected observation hours as in Alternative 1 will give a reliability Code of 1 or 2. The observations will check the accuracy of the counter, obtain average number of people per boat, and the activity engaged in. Without the observations, the system has a reliability code 3.

When doing observations with any of the above alternatives, a form should be used which shows activity engaged in. In this way, these sampling systems can measure fishing, canoeing, powered boating and sailing at the sametime.

Hiking and Horseback Riding

Alternative 1

Registration stations can be set up at trail heads or parking areas where group leaders can register their party. Observations must be taken to determine the registration rate and average group size. Depending on the variability of the observations, this system can give a reliability Code 2. Without the observations, the system has a reliability Code 4.

Alternative 2

Use a pressure plate or infrared counter to obtain total use counts. These alone would give a reliability Code 4. If these counters are used with the double sampling procedure described under Alternative 1, Power Boating, then a reliability Code 2 can be expected.

Alternative 3

Hike some random stretches of trail and count the number of hikers and/or horseback riders going the opposite direction. Set up a system similar to that described under the Hunting activity in Alternative 2. This will give a reliability Code of 3 if use is randomly sampled on at least 10 days. Trail crews may be used to obtain sampling information if the samples are randomly taken.

Swimming and Waterplay

Use the instant count procedure as shown in Appendix 2. This activity often can be sampled along with boating or camping. The reliability code will depend on the variation and intensity of sampling and can be Codes 1, 2 or 3.

Fishing

Alternative 1

Use the instant count procedure as shown in Appendix 2. This procedure will work only when use can be accurately counted from a vantage point. This usually occurs only on lakes. Depending on the statistical analysis, reliability will be Codes 1, 2 or 3.

Alternative 2

Double sample use by counting parked vehicles on randomly selected access points. Follow the procedure as outlined in Boating, Alternative 1. Streams or stream sections may have to be divided into high and low use or the sampling day may have to be divided into high and low use hours. Again, this will depend on the accuracy desired and variation in use expected. The observations will give the average number of fishermen per car. This procedure will probably give a reliability Code of 2.

Camping - Auto, Trailer & Tent

Alternative 1

Double sample areas following the procedure outlined in the RIM Handbook 124.72b. A reliability Code 1 can be expected.

Alternative 2

Follow the reduced intensity double sample procedures explained under Alternative 1 of Boating. The procedures are similar to Alternative 1 above except only 2 hours are sampled per day instead of 12. The results will have to be calculated by hand. A reliability Code 2 can be expected depending on error limitations.

Alternative 3

Use compliance records and fee envelopes on fee sites to determine occupancy. Observations will give the number of people/site and percentage of tents and trailers. Reliability Code 3.

Alternative 4

On small campgrounds, use may be measured using the instant count procedures outlined in Appendix 2. A reliability Code 2 is likely.

Alternative 5

Dispersed camping can be very difficult to measure if it occurs randomly across a district. However, this is usually not the case since most camping occurs along trails or primitive roads.

If code-a-site is being used, these areas can be randomly sampled to determine occupancy rate and size of groups.

If camping occurs along roads or trails and not at specific sites, then use can be measured by dividing the trails or roads into groups (stratify) and sampling as suggested under Alternative 2, Hunter camping.

Picnicking

As illustrated in Appendix 2, the instant count works well in measuring picnicking use. Counters can be used to correlate the use for measuring future years use. Reliability Code 2 can be expected.

Recreation Residence

Alternative 1

Visits to the residences will provide an instant count of the number of residences used and observations will give the average number of people per residence. See Appendix 2 for an example of instant counting. Usually sampling of this activity will be light. If so a reliability Code 3 is expected.

Alternative 2

In the yearly inspections, the permittees can be asked the average number of days the residence was used and the average number of people using it. A reliability Code of 4 will result using this method.

Cross-Country Skiing, Snowshoeing and Snowplay

Alternative 1

At randomly chosen times take a count of vehicles parked at trail locations. Observations can give the percentage of vehicles per activity. Reliability Code 3.

Alternative 2

Use an infrared trail counter for trails and instant count sample for snowplay areas. This would give a reliability Code 4 and if the counter was coupled with observations, a Code 2 or 3 could be reached.

Alternative 3

The trails could be traveled with counts being made as in Alternative 2 of the hunting activity. Reliability Code 3.

Alternative 4

A registration system can be set up as suggested under Alternative 1 under hiking.

Hunting

Alternative 1

Use measurement information can usually be obtained from state fish and game agencies. Michigan DNR districts develop use information by randomly

sampling parked vehicles for license numbers then mailing response forms to the owners of these vehicles. Since their figures cover more than forest ownership, an average use/acre will have to be developed and applied to the net acreage for each ranger district involved. The reliability Code is 4.

Alternative 2

Hunting use is made up of those people camping and hunting from their campsites plus those local people who drive out and park to hunt, plus those local people who hunt while driving the roads. All three types of hunting can be measured by using the following procedures:

1. Divide the roads into similar groups depending on hunting pressure. (Road classes could possibly be used).

2. Randomly select 3 roads in each class with a minimum of 9 total roads.

3. For the hunting season randomly pick 2 weekends; (include holidays) and 2 weekdays.

4. Randomly select two segments of road for each of the roads being sampled. Usually, those are about 10 mile segments.

5. Starting at a randomly selected time during the sampling day, keep track of the following information:

   -- Number of hunting vehicles passing by in the opposite direction.
   -- Number of non-camp vehicles per segment.
   -- Number of camps/segment.
   -- Time it takes to travel and make observations on sample segment of road.
   -- If possible count the number of individuals in hunting vehicles, otherwise use 3.4 as a standard.

6. Observe and estimate the average speed of the hunting vehicles and average number of people/camp.

The data is analyzed in two steps:

A. Hunting by vehicle use is calculated by determining the average vehicles/mile for the lane moving traffic was observed in. The information is treated as if it were instant count data. The vehicles/mile/lane is multiplied by 2 to get vehicles/mile. This is multiplied by miles in the road class, the hours in the use day, average number of hunters/vehicle, and days in the strata (weekend or weekday class) to give hours of use per season for that road class and strata. The hours are then divided by 12 to get RVD's and the individual road classes and strata are totaled to give total RVD's for hunting by vehicle.

The formula for average vehicles/mile/lane is:

$$\frac{V}{OT \quad (L/OT + HS)} = VM$$

V = Moving vehicle count in sample.
VM = Vehicles per mile.
OT = Time it took observer to drive sample road segment in hours.
L = Length or sample road segment.
HS = Average speed hunter travels in mph.

The complete formula is:

$$\frac{VM \cdot MC \cdot 2 \cdot HV \cdot T \cdot SL}{12} = \text{RVD's in road class}$$

MC = Miles of road in class being sampled.
2 = Constant expanding count for both directions of traffic.
HV = Hunters per vehicle or camp.
T = Hours in a use day.
SL = Length of season in days.
12 = Constant to reduce total hours to RVD's

B. **Hunting by campers and local users with parked vehicles are each tallied by calculating the number of camps/mile or non-camp vehicles/mile and expanding in a similar fashion as above.**

The formula to be used for each is:

$$\frac{C \cdot MC \cdot HV \cdot T \cdot SL}{12} = \text{RVD's/road class}$$

C = Camps or non-camp vehicles per mile.

The RVD's for each road class are summed and added to the hunting - drive use to get a total hunting use for the season. The reliability code for this procedure will be 2 or 3.

Gathering Forest Products

Determine the number of free-use permits or maps issued. In conversations with users determine the average number of people cutting on a permit and average number of days a person participates in the activity. The average time spent per day may also be obtained on the standard RVH's shown in Appendix 5 may be used. These factors multiplied together and divided by 12 give RVD's for free-use permits. To this add an estimate (simple observation) of berry pickers etc. to get total use. Reliability Code is 4.

VIS

At VIS sites use measurements may be obtained using the instant count procedures described in Appendix 2. This correlated with traffic counts

would probably give a reliability Code of 2. A counter alone would give a reliability Code of 4. The instant count alone could still give a reliability Code of 2, but could not accurately be used in future years.

General Information

On randomly selected days (approximately 12) the district and S.O. receptionist could keep a count of the time spent informing the public and the number of visitors. This should also be done by collection officers, campground hosts and gate guards. To this add head counts at talks and programs. Reliability Code is 4.

STATISTICAL ANALYSIS

This section is designed to explain the statistical needs and analysis of an accurate sampling system. The description of statistical equations is brief and very simplified. Appendix 1 shows the various formulas.

The first step in devising a sampling system is to determine exactly what information is needed and the budget available for the sampling. Some information that may be needed is: total number of visits, types of users (e.g. age), size of groups, number of groups, length of stay, activities, etc. Dollar limitations may dictate the number of items that can be measured and the accuracy of the system.

After checking other sources for the desired information, review the different sampling methods and select one which fits the situation. If use information for the following few years is desired a predictor variable must be selected. The predictor variable is any constant measurement that has a direct relationship to fluctuations in use (e.g. a traffic counter).

This relationship is calculated with a regression formula. The formula corrects counts by screening out use that is not related to the desired measurement. Use in future years may be measured by recording the counts from the predictor variable rather then sampling every year.

Once the method is selected, use patterns are reviewed to determine if stratification is necessary. This is a means of reducing sampling error by grouping into similar units. For example: All the trails on a district used for snowmobiling may be grouped into a heavy, moderate and light use classes. Randomly selected trails in each of the classes are then sampled with the classes having the most use or highest variation in use being more intensely sampled. This type of sampling results in less variation between the samples in a strata group. In turn, this reduces total error. Appendix 9 shows an example of how the error drops and how to combine strata errors. As recreation oppuntunity spectrum boundaries are determined, they may be used as area stratification boundaries for key activities.

The next step is the difficult task of determining the number of samples needed. To calculate the number of samples needed use the equation shown in Appendix 1. To do this an estimate of the standard deviation is needed. It can be obtained in two ways. They are:

1. <u>From Preliminary Sample</u> Take a preliminary sample and compute the standard deviation for it. This figure plugged into the formula will give the number of samples needed. However, in doing this, over sampling will probably occur. Since the standard deviation from the preliminary sample is based on such a small number of samples, the term is usually much larger than the final standard error term. As a result the indicated number of samples needed is higher than that actually needed. There can be a dramatic difference between these two numbers. Normally, as samples

are collected, the standard deviation and sampling intensity is periodically recomputed. The required number of samples then usually drops. This proceedure is satisfactory as long as use remains fairly constant. But, if for instance, use is light at the beginning and gradually increases throughout the season, then dropping sample days off the middle or end of the season will give an underestimate of use. As an alternative, a lower number of samples may be taken then that indicated necessary by the preliminary sample. This lower estimate will probably be based on dollar limitations and how represenative the preliminary sample appears to be. If the lower sample estimate is too low, the sampling system will not meet the accuracy requirement.

2. <u>From Previous Samples</u> The standard deviation from sampling on similar areas can be used in place of the preliminary sample.

Once the number of samples is determined, it is necessary to select the day, and sometimes hour, the sample will be taken. The data is then collected, the confidence limits and error term calculated, and a rehability code assigned.

Appendix 2 shows an example of the above proceedure. Note that the error term for the sample was 6.5% when all 46 of the samples were taken. The desired 10% error could have been reached with only 33 samples being taken. Also note that the samples were taken randomly. The cost to send an individual to carry out only the sampling would probably be around $600 - $700. By having the maintenance crews and collection officer use a tally sheet which recorded the number of users and time recorded, the manager could do the same job for $100 - $200. Since the crews would have to adjust their routes to get counts covering all hours of the use day, these dollars would cover the scheduling costs and extra travel time for the less efficient travel routes.

Appendix 6 shows T values for given desired error and sample sizes.

SUMMARY

This paper provides the framework for developing a comprehensive use measurement system. Previous research is reviewed and alternatives are established for measuring use for specific activities.

Sampling budgets play a key role in determining the sampling alternative to use. Although costs are not shown due to the differences in each situation, with the information provided costs can be readily calculated for the specific situation.

To provide an additional means of lowering costs, average visitor hour values are listed and some Rim reporting activities were grouped or dropped. Grouping activities should also help to prevent overcounting of use.

A statistual section reviews the basic statistics involved in sampling and provides a means to check the accuracy of the sample. At the same time it can also be used to help prevent oversampling and thereby reduce costs by showing the minimum number of samples needed for a desired accuracy level.

One key point made is to sample for management needs and not just to get numbers. Management needs may include developing carrying capacity for camping near heavily used lakes or a report to Congress.

Once familiar with these statistical methods and the techniques, sampling should be easier and less costly. However, unless there is a push for accomplishments in measuring use, such as hard targets, the proposed system will probably not be used.

LITERATURE CITED

Bury, Richard L. 1964. Information on campground use and visitor characteristics. USDA Forest Service. Berkeley, Research Note PSW-43. 3 p.

Chippewa County Road Commission. 1979. County Traffic Records: Chippewa County, Michigan. Sault Ste. Marie.

Deland, Loren F. 1976. Development of the Forest Service Trail Traffic Counter. USDA Forest Service. Epuipment Development and Test Report 7700-10. Montana.

Deland, Loren F. 1977. Inductive Loop - Their Design, Installation, and Maintenance for Road Traffic Surveillance - USDA Forest Service. Equipment Development and Test Report 7700-9. Missoula, Montana.

Driessen, Jon J. 1979. Equipment for gathering visitor use data: a progress report, fiscal year 1978. Equipment Development and Test Project 8018. Equipment Development Center. Missoula, Montana. 23 p.

Elsner, Gary H. 1970. Camping use-axle count relationship: estimation with desirable properties. Forest Science. 16(4): 493-495.

Elsner, Gary H. 1971. Using error measures to compare models on recreation use. Journal of Leisure Research 3(4): 277-278.

Forest Servise. 1980. Equipment Development and Test Program 1979-1980, Progress and Plans. Washington D.C.

Hogans, Mack L. 1978. Using photography for recreation research. USDA Forest Service. Portland. Research Note PNW-327. 11 p.

James, George A. and Robert K. Henley. 1968. Sampling procedures for estimating mass and dispersed types of recreation use on large areas. USDA Forest Service. Asheville. Research Paper SE-31. 15 p.

James, George A. and Gary L. Tyre. 1967. Use of water meter records to estimate recreation visits and use on developed sites. USDA Forest Service. Asheville. Research Note SE-73. 3 p.

James, George A., Nelson W. Taylor, and Melvin L. Hopkins. 1971. Estimating recreational use of a unique trout stream in the coastal plains of South Carolina. USDA Forest Service. Asheville. Research Note SE-159. 7 p.

James, George A., H. Peter Wingle, and James D. Griggs. 1971. Estimating recreation use on large bodies of water. USDA Forest Service. Asheville. Research Paper SE-79. 7 p.

James, George A. and Anthony K. Quinkert. 1972. Estimating recreational use at development observation sites. USDA Forest Service. Research Paper SE-97. 6 p.

James, George A. and Hans T. Schreuder. 1972. Estimating dispersed recreation use along trails and in general undeveloped areas with electric-eye counters: some preliminary findings. USDA Forest Service. Asheville. Research Note SE-181. 8 p.

Leonard, R.E., H.E. Echelberger, H.J. Plumley, and L.W. VanMeter. 1980. Management guidelines for monitoring use on backcountry trails. USDA Forest Service. Broomall. Research Note NE-286. 20 p.

McCurdy, Dwight R. 1970. A manual for measuring public use on wild lands—parks, forests and wildlife refuges. School of Agriculture. Southern Illinois University. Carbondale. School of Forestry Publication No. 5. 48 p.

Mar[illegible], Leo F. 1977. Methods for counting river recreation users. [illegible]roceedings: River Recreation Management and Research. USDA Forest Service. St. Paul. General Technical Report NC-28. pp. 77-82

Michigan Department of State Highways and Transportation, 1978. 1977 Average 24 Hour Traffic Flow Map. Report No. 223. Lansing, MI.

Moncrief, Lewis. 1980. Energy Issues for Outdoor Recreation. Clemson University lecture. Michigan State University. East Lansin, MI.

Robson, D.S. 1960. An unbiased sampling and estimation procedure for reel census of fishermen. Biometrics. 16(2):261-277.

Schreuder, Hans T., Gary L. Tyre, and George A. James. 1975. Instant - and interval-count sampling: two new techniques for estimating recreation use. Forest Science. 21(1):40-44.

Saunders, Paul Richard. 1980. A system for uniform recreation use monitoring and reporting on the Arapaho and Roosevelt National Forests and the Pawnee National Grassland. Research Report No. 20. Clemson University. Clemson, South Carolina.

Tombaugh, Larry W. and L.D. Love. 1964. Estimating numbers of visitors to national forest campgrounds. USDA Forest Service. Ft. Collins. Research Note RM-17. 4 p.

Tyre, Gary L. and Gene R. Welch. 1972. Program manual for estimating use and related statistics on developed recreation sites. USDA Forest Service. Asheville. General Technical Report SE-1. 4 p.

Wager, J. Alan. 1969. Estimation of visitor use from self-registration at developed recreation sites. USDA Forest Service. Ogden. Research Paper INT-70. 17 p.

APPENDIX

APPENDIX 1

Statistical Formulas

Standard Deviation (s): This is the amount of variation of individual samples around the average

$$S = \sqrt{\frac{\Sigma x^2 - (\Sigma x)^2/n}{n - 1}} \quad \text{or} \quad \sqrt{\frac{(x - \bar{x})^2}{n - 1}}$$

Coefficient of Variation: Ratio of standard deviation about the mean

$$CV = \frac{S}{\bar{x}} (100)$$

Standard error of the Mean:

$$S_{\bar{x}} = \frac{s}{\sqrt{n}} \sqrt{\frac{N - n}{N}}$$ for use with finite or small populations

Use for determing sample size and confidence limits

$$S_{\bar{x}} = s/\sqrt{n}$$ for use with infinite or large populations

Confidence Limits: Probability that the sample mean is a specified distance from the true mean.

Use a distribution of t table, select confidence limits and use this with degrees of freedom (d.f.) which = n - 1 to find t value

$$C.L. = \bar{x} \pm t\,(S_{\bar{x}}) \quad \text{or} \quad \bar{x} - t\,S_{\bar{x}} \text{ to } \bar{x} + t\,S_{\bar{x}}$$

Limits are good only when sampling is unbiased

Sampling Intensity: For standard deviation need preliminary estimate or use of S from previous or similar sample n =

$$\frac{t^2\,S^2}{E^2}$$ where: t is from t table (see Appendix 6) and E is desired half width of confidence limits.

Appendix 1 continued

Combining Strata Errors: Also see appendix 8 for example

$$\text{Total } S_{\bar{x}} \text{ in } \% = \sqrt{\frac{\Sigma(\text{Strata RVD's} \times \text{Strata error } \%)^2}{\text{Total RVD's}}}$$

Regression Analysis: See Rim handbook for formula and example 124.74c

Instant Count: Total use in RVD's = $Lo/12 \cdot \bar{x}$

Where: Lo = Total season length in hours

12 = A standard to reduce hours to visitor days (RVD's)

$\bar{x}$ = The average number of people per instant count

APPENDIX 2

Instant Count Example

Objective: Measure picnicing use at Three Lakes Picnic area so that we are 80% confident that our results will be within 10% of the total visitor days.

1). As they make their rounds over the next two weeks, the maintenance crews and collection officer record the number of people at site: 10, 14, 4, 8, 2, 12, 6, 10, 4, 8 then: $n = 10$ $\bar{x} = 7.8$ $\Sigma x^2 = 740$ $\Sigma x = 78$.

The area is open 12 hrs/day for 170 days. Length open = Lo = 2040 hours.

Then use in Recreation Visitor Days (R.V.D's.) = $Lo/12 \cdot \bar{x} = (2040/12) \cdot 7.8 = 1326$ R.V.D's. = U

Standard Deviation: = $3.82 = \sqrt{\dfrac{740 - (78)^2/10}{(10 - 1)}}$ in people at site, then $3.82 \cdot Lo/12 = 649$ R.V.D's.

Number of Samples needed: = $n = \dfrac{t^2 s^2}{E^2}$ or $\left(\dfrac{ts}{E}\right)^2$ where:

a). $t = 1.383$ with degrees of freedom at $n - 1 = 9$ and 20% or .2 chance of error (we wanted to be 80% confident, so $1.0 - .8 = .2$).

b). E = desired $\pm$ width of confidence limits. We want to be within 10% of total visitor days. Preliminary figures show use at 1326 R.V.D's. 10% of 1326 = 133 = E.

c). S in R.V.D's. = 649, then $n = \left[\dfrac{(1.383)\ (649)}{133}\right]^2 = 45.5 =$ 46 samples

2). 46 randomly sampled days and times are then selected. The results are $\bar{x} = 6.6$ people/count. Use = 6.6 (2040/12) = 1122 R.V.D's. t at 45 d.f. and 20% chance of error = 1.3 $S_{\bar{x}}$ = 1.3 (73) = 1122 $\pm$ 95. We are 80% confident that the recreation use is between 1027 and 1217 R.V.D's.

Alternatives:

A). Since the above is a random sample the statistical analysis is sound. Other ways of getting the counts would be to have various district people record the number of people at the rate as they perform their work. Since these would not be random counts the analysis would not be valid. However, if enough counts were made at various times, a random sample could be selected from these counts.

Estimators prefer to take only random samples since the statistical analysis applies only to random sampling. However, it should be noted that most timber cruises are made from a systematic sample. Recreation use could be done this way also and as long as care is taken not to let bias enter, the statistical analysis could give us an idea of our success. A trade off between sampling cost and accuracy would then be made. The estimator must assess the importance of accuracy.

B). On heavily used sites it may be preferable to stratify sampling. For example sampling may be broken down into heavy and light use days or even hours. The heavier use portion could then be sampled more intensively based on something such as % of total use.

APPENDIX 3

Equipment Sources

1). <u>Pulsed Infrared Beam</u>

Scientific Dimmensions, Inc.
309 McKnight N.E.
Albuquerque, N.M. 87107
Phone 505-247-9180

Two models are available

TB - TCS - 90	Maximum seperation of 75 feet
TCS - 90 - 01	Maximum seperation of 120 feet

Cost is approximately $400.00

2). <u>Pneumatic Counter</u>

K-Hill Signal Co.
Uhrichsville, Ohio 44683
Phone 614-922-0421

or

Streeter Amet
Grayslake, ILL 60030
Phone 312-223-4001

Their Jr. Trafficounter costs about $140.00

3). <u>Magnetic Loop Counter</u>

Traffic Data Systems, Inc.
P.O. Box 7009
Colorado Springs, Colo. 80907
Phone 303-473-5210

Model LDC 355 Costs about $250.00

Belden Corp.
Gov't Sales Rep.
P.O. Box 1331
Richmond, Ind. 47347
Phone 317-966-6661

Loopwire 14AWG, polyethylene jacket. Code No. YR-14903

Cost: About $60.00 for 1000-foot roll.

Appendix 3 continued

4). <u>Pressure Plate System</u>

See Appendix 4

APPENDIX 4

Managing a Pressure Plate Counter System

A. *The components:*

1. Mat switch: "Tapeswitch Signal Mat" model CVP-1723
   Tapeswitch Corporation of America
   100 Schmitt Blvd.
   Farmingdale, NY 11735

2. Sandwich: 3/8" plywood
   1/8" tempered hardboard
   2" wide duct tape
   5 mil plastic trash bag
   burlap bag

3. Counter: Sodeco TCeZ4E (made in Switzerland)
   Landis & Gyr
   4 Westchester Plaza
   Elmsford, NY 10523

4. Battery: Standard 6-volt lantern-type battery
   Eveready #731

5. Plastic container: 3-qt plastic storage container with well-fitted lid to store battery and counter below ground surface.

(Addresses given are for national distributors; local retailers can be determined by writing to these addresses.)

The mat switch is simply sandwiched between the plywood and hardboard and the edges of the sandwich sealed with duct tape. The sandwich is then placed in the trash bag to protect it from moisture and covered with the burlap to provide a rough surface which will hold soil and forest litter.

B. *Placement:*

1. *Trail width.* Ideally, pressure plates should be located on trails that are little wider than 18 inches, the width of the mat. Heavily used trails are rarely that narrow, so obstructions must be used to funnel users single-file over the plate. They should be large enough to divert hikers, e.g., large rocks, large dead trees or limbs, and so placed to conceal their purpose.

2. *Slope.* Because paces and strides vary greatly on steep pitches, extreme slopes should be avoided. A flat or nearly flat stretch of trail assures even, steady foot pressure.

3. *Drainage.* Although the plastic bag should make the sandwich watertight, poorly drained places should be avoided. Mucky organic soil does not transmit foot pressure as well or as consistently as better drained mineral soils. The organic soil can also retain much water and become heavy. Rocky or stoney soils may be too heavy for the pressure plate, and keep the mat switch closed continuously.

Proper placement of the counter is critical. It may be well worth the time to walk the entire stretch of trail to be monitored before placing the counter, to locate an area that will meet as many of the site requirements as possible.

C. *Installation:*

Once a site has been selected, installation can begin. It is usually best to install counters at off-peak times to minimize the chance of discovery by users.

1. Excavate to a 4- or 5-inch depth an area slightly larger than the pressure plate. Care should be taken to smooth the bottom of the excavation and remove protruding rocks and roots.

2. Place the plate in the excavation and run the leads, with splices, to a point selected for burying the battery and counter.

3. Bury the leads at least 4 inches deep.

4. Attach the leads to the counter and battery. Polarity is not important. Running the leads through a small hole beneath the lip of the plastic container lid will help to keep moisture out of the container.

5. Bury the container and cover the top with a flat rock or twigs and leaves.

6. Cover the plate with soil and forest litter—sift out rocks and other debris. Test the buried counter by stepping lightly and then firmly over the entire plate area. If too little soil is over the plate, it may double-count. If too much soil is over the plate, it may miss counts.

7. Once any adjustments are made for plate cover, restore the site to as near a natural appearance as possible.

8. If possible, wait to observe a number of hikers as they pass over the plate. Some unanticipated problems may be observed.

D. *Maintenance:*

A maximum recommended maintenance interval is 2 or 3 weeks. The more frequently the counter is checked, of course, the more reliable the data will be.

Maintenance should include:

1. Recording the number on the counter.

2. Walking over the trail a number of times at different paces and strides to be sure the system is functioning properly.

3. Either zeroing the counter or recording the new figure so that test counts won't get confused with actual use counts.

4. Checking the battery strength with a voltmeter. Weak batteries may cause miscounts.

5. Checking the site to be sure there are no tell-tale signs of the plate, wires, or battery container.

E. *Troubleshooting:*

In making field checks, maintainers should always carry extra components and a tool kit (folding shovel, pliers, knife, etc.). This troubleshooting chart is based on the most common malfunctions, and their remedies, in order of likelihood:

1. Counter does not work at all:
   a. Dead battery.
   b. Bad connection.
   c. Bad splice.
   d. Soil too heavy over plate (frequently sodden after rain).
   e. Malfunctioning mat switch.
   f. Malfunctioning counter.
2. Counter double-counts periodically:
   a. Too little soil over the plate.
   b. Rocky soil over the plate.
   c. Warped or twisted plate.
3. Counter misses counts intermittently:
   a. Battery weak.
   b. Bad connections or splices.
   c. Too much soil over plate.
   d. Soil compacted over plate; dig up plate and replace in same spot with looser soil on it.
   e. Malfunctioning mat switch or counter.

Setting Up a Photoelectric Counter System

A. *Installation*

Installation of infrared counters is of critical importance. Most of the reported problems with the counters appear to be related to improper installation. The instruction book prepared by Scientific Dimensions, Inc., which accompanies each counter, should be followed closely, with special attention to:

- Selecting trees for scanner and reflector which will not move substantially in the wind.
- Selecting a site where hikers will pass by in single file and where there is little temptation for hikers to stop to view the scenery or wait for friends.
- Aiming the beam at waist level (about 3½ feet).
- Centering the reflector in the scanner beam and not separating the two by more than 75 feet (for standard scanner). The manufacturer recommends reducing that distance

by 30 percent to 50 percent in areas expected to be in dense fog periodically (52 feet or 37½ feet, respectively).

- Clearing branches and underbrush which might be blown in front of the scanner.
- Burying the battery box to protect it from extremes in temperature.
- Checking the beam alignment a few days after the installation to be sure the components have not settled.

Installation may be easier with the following suggestions:

- Have two people set up the counter rather than one.
- Use a string attached to the scanner to help locate the proper position of the reflector and/or attach several reflectors to a stick to minimize the amount of time spent groping about for the infrared beam.

The potential for vandalism or theft can be reduced by:

- Making the installation at "off-peak" use times.
- Affixing the scanner to the tree so a minimum of it shows.
- Camouflaging the reflectors by placing them on birch trees or the butt ends of sawed logs, or "decorating" the edge of the reflector with plant and leaf trimmings.
- Using a variety of paths when maintaining the scanner, none of which leads directly from the trail being monitored.

B. *Maintenance*

Replacement batteries and reflectors, as well as a tool kit, should always be carried. A pocket voltmeter will help anticipate miscounting due to weak batteries. The manufacturer recommends replacing the batteries when voltages have dropped 20 percent.

Because the digital impulse counter on the scanner cannot be zeroed, maintainers must be careful to record the reading at the beginning and end of each field check. The difference between the two figures should not be included in the traffic counts because they are simply a result of maintenance activity.

Reprinted from Leonard, et. al., Management Guidelines for Monitoring Use on Back County Trails. Research Note. NE - 286

APPENDIX 5

Acceptable Activities
and
Related Recreation Visitor Hour Values (RVH)

Rim Code	Activity
1.1	Viewing Outstanding Scenery - only for overlooks and similar wayside areas. .25 RVH
11.1	Driving for Pleasure - four wheel vehicles, excluding four wheel drive and off-road vehicles (ORV). RVH based on road lenth within forest at speed limit.
11.2	Motorcycling and Off-Road - RVH same as Driving for Pleasure, 5 RVH for ORV's.
11.3	Snowmobiling - 5 RVH or based on trail length and speed of travel.
12.2	Boat Powered - 6 RVH.
14.1	Hiking - 1 RVH for trails associated with campgrounds. 8 RVH for backpacking.
14.3	Horseback Riding - 6 RVH.
15.1	Canoeing - 5.2 RVH.
15.2	Sailing - 4.0 RVH.
22.1	Swimming and Waterplay - includes water skiing. 2 RVH.
31.1	Fishing - all types of fishing. 6 RVH.
41.2	Camping: Auto - includes camping general - self contained and self propelled units. 15 RVH.
41.3	Camping: Trailer - Towed Unit. 15 RVH.
41.4	Camping: Tent - also includes just sleeping bags. 15 RVH.
43.1	Picnicing - 2 RVH.
46.3	Recreation Residence - private residences under permit. 18 RVH.
51.5	Cross-Country Skiing and Snowshoeing - also sledding and other snowplay. 4 RVH.
61.1	Hunting - all types. 8 RVH

Appendix 5 continued

Rim Code	Activity
64.1	Gathering Forest Products - Firewood 6 RVH, Christmas Trees 2 RVH and Berry Picking 4 RVH.
81.1	Vis Related Activities - other than general information. 25 RVH
81.9	General Information - information and interpretation given by a trained uniformed person. .25 RVH.

APPENDIX 6

Distribution of t

df	Probability								
	0.5	0.4	0.3	0.2	0.1	0.05	0.02	0.01	0.001
1	1.000	1.376	1.963	3.078	6.314	12.706	31.821	63.657	636.619
2	0.816	1.061	1.386	1.886	2.920	4.303	6.965	9.925	31.598
3	0.765	0.978	1.250	1.638	2.353	3.182	4.541	5.841	12.941
4	0.741	0.941	1.190	1.533	2.132	2.776	3.747	4.604	8.610
5	0.727	0.920	1.156	1.476	2.015	2.571	3.365	4.032	6.859
6	0.718	0.906	1.134	1.440	1.943	2.447	3.143	3.707	5.959
7	0.711	0.896	1.119	1.415	1.895	2.365	2.998	3.499	5.405
8	0.706	0.889	1.108	1.397	1.860	2.306	2.896	3.355	5.041
9	0.703	0.883	1.100	1.383	1.833	2.262	2.821	3.250	4.781
10	0.700	0.879	1.093	1.372	1.812	2.228	2.764	3.169	4.587
11	0.697	0.876	1.088	1.363	1.796	2.201	2.718	3.106	4.437
12	0.695	0.873	1.083	1.356	1.782	2.179	2.681	3.055	4.318
13	0.694	0.870	1.079	1.350	1.771	2.160	2.650	3.012	4.221
14	0.692	0.868	1.076	1.345	1.761	2.145	2.624	2.977	4.140
15	0.691	0.866	1.074	1.341	1.753	2.131	2.602	2.947	4.073
16	0.690	0.865	1.071	1.337	1.746	2.120	2.583	2.921	4.015
17	0.689	0.863	1.069	1.333	1.740	2.110	2.567	2.898	3.965
18	0.688	0.862	1.067	1.330	1.734	2.101	2.552	2.878	3.922
19	0.688	0.861	1.066	1.328	1.729	2.093	2.539	2.861	3.883
20	0.687	0.860	1.064	1.325	1.725	2.086	2.528	2.845	3.850
21	0.686	0.859	1.063	1.323	1.721	2.080	2.518	2.831	3.819
22	0.686	0.858	1.061	1.321	1.717	2.074	2.508	2.819	3.792
23	0.685	0.858	1.060	1.319	1.714	2.069	2.500	2.807	3.767
24	0.685	0.857	1.059	1.318	1.711	2.064	2.492	2.797	3.745
25	0.684	0.856	1.058	1.316	1.708	2.060	2.485	2.787	3.725
26	0.684	0.856	1.058	1.315	1.706	2.056	2.479	2.779	3.707
27	0.684	0.855	1.057	1.314	1.703	2.052	2.473	2.771	3.690
28	0.683	0.855	1.056	1.313	1.701	2.048	2.467	2.763	3.674
29	0.683	0.854	1.055	1.311	1.699	2.045	2.462	2.756	3.659
30	0.683	0.854	1.055	1.310	1.697	2.042	2.457	2.750	3.646
40	0.681	0.851	1.050	1.303	1.684	2.021	2.423	2.704	3.551
60	0.679	0.848	1.046	1.296	1.671	2.000	2.390	2.660	3.460
120	0.677	0.845	1.041	1.289	1.658	1.980	2.358	2.617	3.373
∞	0.674	0.842	1.036	1.282	1.645	1.960	2.326	2.576	3.291

d.f. = degrees of freedom = (n-1)

APPENDIX 7

RECREATION OPPORTUNITY SPECTRUM

The associated activity opportunities, recreational setting requirements, and experience opportunities that are highly probable for each Recreation Opportunity Spectrum class. There may be specific activity exceptions to these general characteristics. (This table is for illustrative purposes only. Use the six Recreation Opportunity Spectrum class delineation criteria to identify actual areas.)

Spectrum Class	Primitive (P)	Semi-primitive non-motorized (SPNM)	Semi-primitive motorized (SPM)	Roaded Natural Appearing (RN)	Rural (R)	Modern-urban (MU)
Activity Oppor-tunities	Viewing Outstanding Scenery Enjoying Unique and/or Unusual Environments Hiking Cross-country ski touring and snowshoeing Horseback Riding Canoeing Sailing Other, nonmotorized watercraft use Swimming Diving (Skin or Scuba) Fishing Photography Camping Snowplay Hunting (big, small game, upland birds and waterfowl) Nature Study Acquiring General Knowledge/Understanding Unguided Hiking General Information		Viewing Outstanding Scenery Enjoying Unique and/or Unusual Environments Hiking Cross-country ski touring and snowshoeing Horseback Riding Canoeing Sailing Other, nonmotorized watercraft use Swimming Diving (Skin or Scuba) Fishing Photography Camping Snowplay Hunting (big, small game, upland birds and waterfowl) Nature Study Acquiring General Knowledge/Understanding Unguided Hiking General Information Motor-driven ice and snowcraft ORV touring Power boating	Viewing Outstanding Scenery Enjoying Unique and/or Unusual Environments Hiking Cross-country ski touring and snowshoeing Horseback Riding Canoeing Sailing Other, nonmotorized watercraft use Swimming Diving (Skin or Scuba) Fishing Photography Camping Snowplay Hunting (big, small game, upland birds and waterfowl) Nature Study Acquiring General Knowledge/Understanding Unguided Hiking General Information Motor-driven ice and snowcraft ORV touring Power boating Picnicking Gathering Forest Products Auto Touring Water Skiing & Other Water Sports Automobile Camping Trailer Camping Viewing Interpretive Signs Organization Camping Lodges Resort-Commercial Public Services Resort-Lodging	Viewing Outstanding Scenery Enjoying Unique and/or Unusual Environments Hiking Cross-country ski touring and snowshoeing Horseback Riding Canoeing Sailing Other, nonmotorized watercraft use Swimming Diving (Skin or Scuba) Fishing Photography Camping Snowplay Hunting (big, small game, upland birds and water fowl) Nature Study Acquiring General Knowledge/Understanding Unguided Hiking General Information Motor-driven ice and snowcraft ORV touring Power boating Picnicking Gathering Forest Products Auto Touring Water Skiing & Other Water Sports Automobile Camping Trailer Camping Viewing Interpretive Signs Organization Camping Lodges Resort-Commercial Public Services Resort-Lodging Competition Games Ice Skating Scooter-Motorcycle Use Bicycling Spectator Sports Jogging Passive use of developed parks and open space Picnicking Outdoor Concerts	
Recrea-tional Settings	Area is characterized by essentially unmodified natural environment of fairly large size. Interaction between users is very low and evidence of other area users is minimal. The area is managed to be essentially free from evidence of man-induced restrictions and controls. Motorized use within the area is not permitted.	Area is characterized by a predominantly natural or natural-appearing environment of moderate-to-large size. Interaction between users is low, but there is often evidence of other users. The area is managed in such a way that minimum on-site controls and restrictions may be present, but are subtle. Motorized use is not permitted.	Area is characterized by a predominantly natural or natural-appearing environment of moderate-to-large size. Concentration of users is low, but there is often evidence of other users. The area is managed in such a way that minimum on-site controls and restrictions may be present, but are subtle. Motorized use is permitted.	Area is characterized by predominantly natural appearing environments with moderate evidences of the sights and sounds of man. Such evidences usually harmonize with the natural environment. Interaction between users may be low to moderate, but with evidence of other users prevalent. Resource modification and utilization practices are evident, but harmonize with the natural environment. Conventional motorized use is provided for in construction standards and design of facilities.	Area is characterized by substantially modified natural environment. Resource modification and utilization practices are primarily to enhance specific recreation activities and to maintain vegetative cover and soil. Sights and sounds of man are readily evident, and the interaction between users is often moderate to high. A considerable number of facilities are designed for use by a large number of people. Facilities are often provided for special activities. Moderate densities are provided far away from developed sites. Facilities for intensified motorized use and parking are available.	Area is characterized by a substantially urbanized environment, although the background may have natural-appearing elements. Renewable resource modification and utilization practices are to enhance specific recreation activities. Vegetative cover is often exotic and manicured. Sights and sounds of man, on-site, are predominant. Large numbers of users can be expected, both on-site and in nearby areas. Facilities for highly intensified motor use and parking are available with forms of mass transit often available to carry people throughout the site.
Experi-ence Oppor-tunities	Extremely high probability of experiencing considerable isolation from the sights and sounds of man, independence, closeness to nature, tranquility, and self-reliance through the application of woodsman skills in an environment that offers a high degree of challenge and risk.	High, but not extremely high, probability of experiencing the above listed natural environment elements.	Moderate probability of experiencing the above listed natural environment elements, except that there is a high degree of interaction with the natural environment. Opportunity is available to use motorized equipment while in the area.	About equal probability to experience affiliation with other user groups and for isolation from sights and sounds of man. Opportunity to have a high degree of interaction with the natural environment. Challenge and risk opportunities associated with more primitive type of recreation are not very important. Practice and testing of outdoor skills might be important. Opportunities for both motorized and non-motorized forms of recreation are possible.	Probability for experiencing affiliation with individuals and groups is prevalent as is the convenience of sites and opportunities. These factors are generally more important than the setting of the physical environment. Opportunities for wildland challenges, risk-taking, and testing of outdoor skills are generally unimportant except for specific activities like downhill skiing, for which challenge and risk-taking are important elements.	Probability for experiencing affiliation with individuals and groups is prevalent, as is the convenience of sites and opportunities. Experiencing natural environments, having challenges and risks afforded by the natural environment, and the use of outdoor skills are relatively unimportant. Opportunities for competitive and spectator sports and for passive uses of highly man-influenced parks and open spaces are common.

APPENDIX 8

Road Class Summary

District	I 15 MPH FS Primitive	II 30 MPH FS Improved	III 40 MPH County	IV 50 MPH Forest Highways
Rapid River	258	56	45	37
Manistique	447	58	52	27
Munising	368	49	95	52
Sault Ste. Marie	433	125	41	51
St. Ignace	240	84	14	52
Total	1746	372	247	219

Information Source: Transportation Plans

APPENDIX 9

Combining Strata Errors

<u>Situation:</u> Roads were divided into two classes and the season was divided into weekdays and weekend days. Hunting use was sampled so that each strata had 3 samples taken. The results are:

<u>Strata 1:</u> (Weekday use on class I roads)

Sample day	x (No. of Hunters)	x^2
11/20	9	81
11/24	15	225
11/26	3	9
Total = Σx =	27	Σx^2 = 315

$S = 6.00$
$S_{\bar{x}} = 3.46 = 38.4\%$
$\bar{x} = 9$
Days in Strata = N = 11
Strata use = (N) = 99 RVD's

<u>Strata 2:</u> (Weekday use on class II roads)

Sample day	x (No. of Hunters)	x^2
11/20	9	81
11/24	27	729
11/26	24	576
Total = Σx =	60	Σx^2 = 1386

$S = 9.64$
$S_{\bar{x}} = 5.57 = 27.6\%$
$\bar{x} = 20$
$N = 11$
Strata use = 220 RVD's

<u>Strata 3:</u> (Weekend use on class I roads)

Sample day	x (No. of Hunters)	x^2
11/21	12	144
11/28	18	324
11/29	24	576
Total = Σx =	54	Σx^2 = 1044

$S = 6.00$
$S_{\bar{x}} = 3.46 = 19.2\%$
$\bar{x} = 18$
$N = 5$
Strata use = 90

<u>Strata 4:</u> (Weekend use on class II roads)

Sample day	x (No. of Hunters)	x^2
11/21	30	900
11/28	21	441
11/29	18	324
Total Σx =	69	Σx^2 = 1665

$S = 6.24$
$S_{\bar{x}} = 3.60 = 15.7\%$
$\bar{x} = 23$
$N = 5$
Strata use = 115

Appendix 9 continued

The formula for combining errors is:

$$\text{Total } 3\,\bar{\bar{x}} \text{ in } \% = \frac{\sqrt{\sum(\text{strata RVD's} \times \text{strata error } \%)^2}}{\text{Total RVD's}}$$

For the above example:

$$\frac{\sqrt{(99 \times 38.4)^2 + (220 \times 27.6)^2 + (90 \times 19.2)^2 + (115 \times 15.7)^2}}{(99 + 220 + 90 + 115)}$$

$= 14.5\ \%$ Total sampling error